Science Mission Directorate
National Aeronautics and Space Administration

UAH

AIRS DATA ASSIMILATION AT THE SPoRT CENTER

Will McCarty

University of Alabama in Huntsville
Huntsville, Alabama

and

Gary Jedlovec

NASA / Marshall Space Flight Center
Huntsville, Alabama

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transitioning unique NASA data and research technologies to the NWS

Presentation Outline

- Brief Intro to SPoRT
- Motivation
- Methodology of Assimilation
- Assessment of Cloud Contamination
- Initial Results of Assessment
- Initial Validation Approaches
- Moving Forward

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NASA's Short-term Prediction and Research Transition (SPoRT) Center

Mission: Apply NASA measurement systems and unique Earth science research to improve the accuracy of short-term (0-24 hr) weather prediction at the regional and local scale (http://weather.msfc.nasa.gov/sport/)

Test-bed for rapid prototyping of new products

Transition research capabilities / products to operations

- real-time MODIS data and products to 6 NWS forecast offices
- twice daily WRF model output (initialized with MODIS SSTs)- operational
- convective initiation / lightning products for nowcasting severe weather

Development of new products and capabilities for transition

- MODIS SST composites, AMSR-E rain rates, and ocean color products
- assimilation of AIRS radiances and thermodynamic profiles into regional forecast models

SPoRT

transitioning unique NASA data and research technologies to the NWS

AIRS Radiance Assimilation in Regional Models

Motivation for Radiance Assimilation

- Show the utility of hyperspectral radiance assimilation at the regional scale
  - radiances are not used operationally at NCEP in the NAM
  - regional assimilation allows for the possibility to use every AIRS footprint
  - smaller-scale features in the radiances are retained
- By using more AIRS footprints spatially, cloud contamination becomes even more likely
  - optimize / refine the selection of cloud-free channels. Thus, cloud contamination needs to be assessed

AIRS Radiance Assimilation in Regional Models

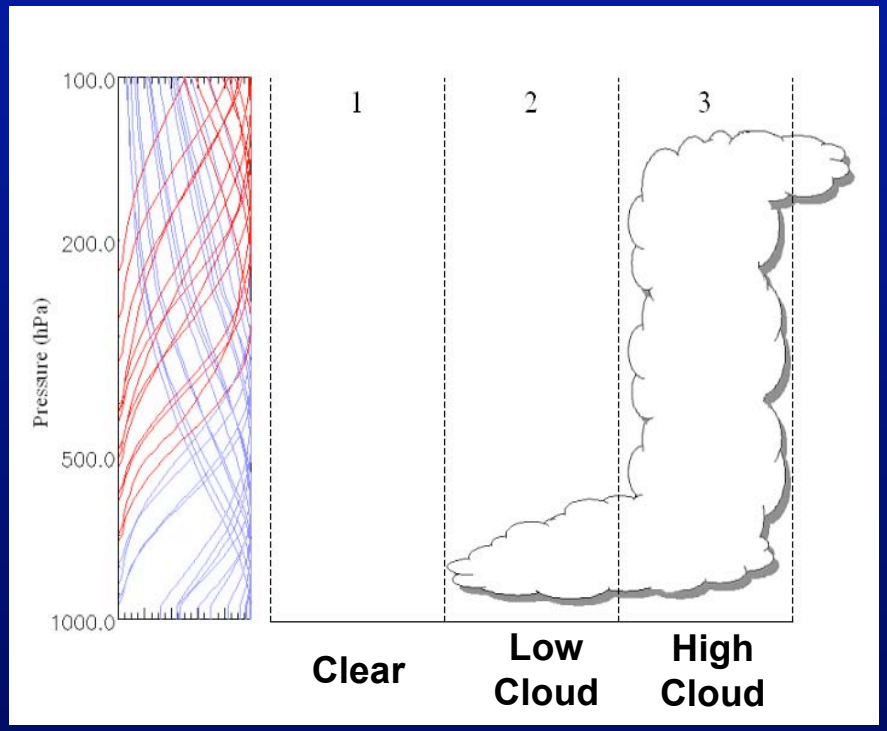
Methodology of Radiance Assimilation

- Radiance assimilation is performed using 3DVAR within the GSI system
  - Operational assimilation system at NCEP
  - Also implemented by GSFC-GMAO (GEOS-5) and ESRL (WRF-ARW application to RUC-replacement)
  - Implementation with SPoRT focus
  - JCSDA Visit – Summer 2006
- Modeling improvement will be investigated using the WRF-NMM
  - Current and foreseeable NAM
  - GSI and WRF-NMM already linked for use at NCEP/EMC
  - Transition Forecast improvements to operations (goal of SPoRT and JCSDA)

AIRS Radiance Assimilation in Regional Models

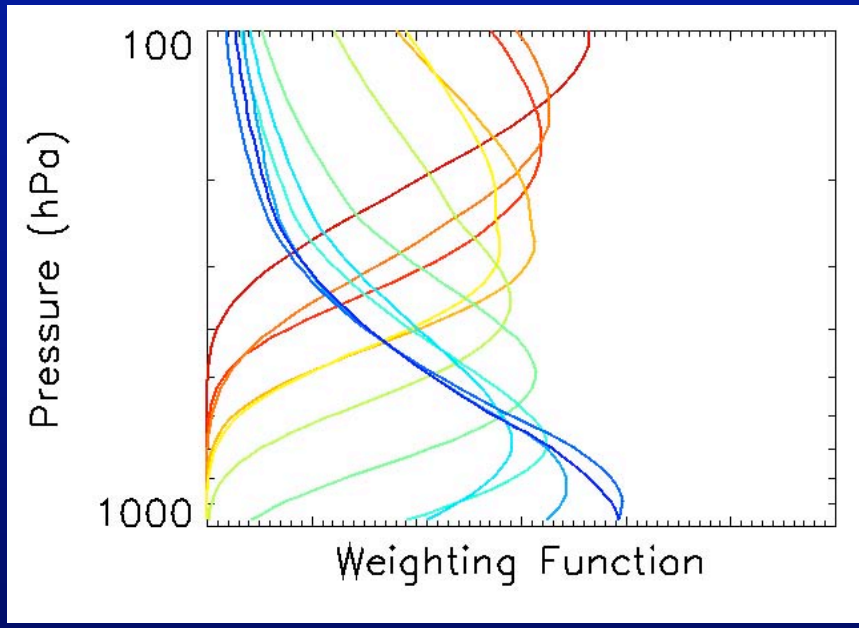
Assessment of Cloud Contamination

- Cloud detection already inherent within GSI
  - Cloud detection technique for infrared radiances is instrument independent
  - Essentially a ΔBT (obs – calc) test
- Two additional techniques implemented within the GSI
  - Utilize Hyperspectral Radiances



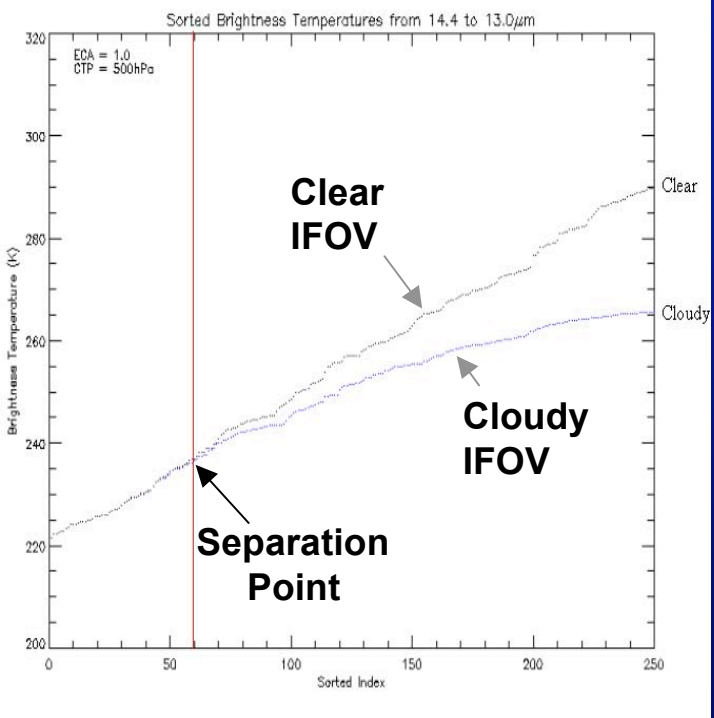
AIRS Radiance Assimilation in Regional Models

- CO_2 Slicing Approach
  - CO_2 Slicing CTP and ECF retrieval in AIRS BUFR stream (McCarty and Jedlovec 2006)
  - Contamination assessed by comparing CTP and transmittance
- CO_2 Sorting Technique
  - based on methodology of Holz et al. 2006
  - direct use of radiances, not a physical retrieval, to determine cloud contamination



AIRS Radiance Assimilation in Regional Models

Assessment of Cloud Contamination



- Use CO2 sorting approach to explicitly identify channels contaminated by clouds
  - Contaminated and uncontaminated channels
  - Position of the separation point function of CTP
  - Magnitude of the separation is a function of ECF
  - The Challenge of this method is the determination of the separation point

Impact:

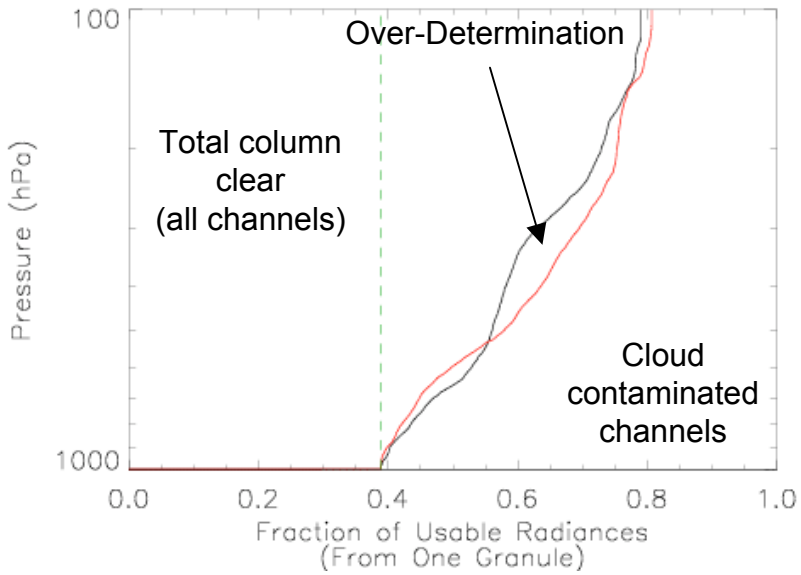
- 2-3 factor increase in radiances (over masking approach)
- Data added in meteorologically significant regions (above clouds)

AIRS Radiance Assimilation in Regional Models

Separation Point (SP) Determination

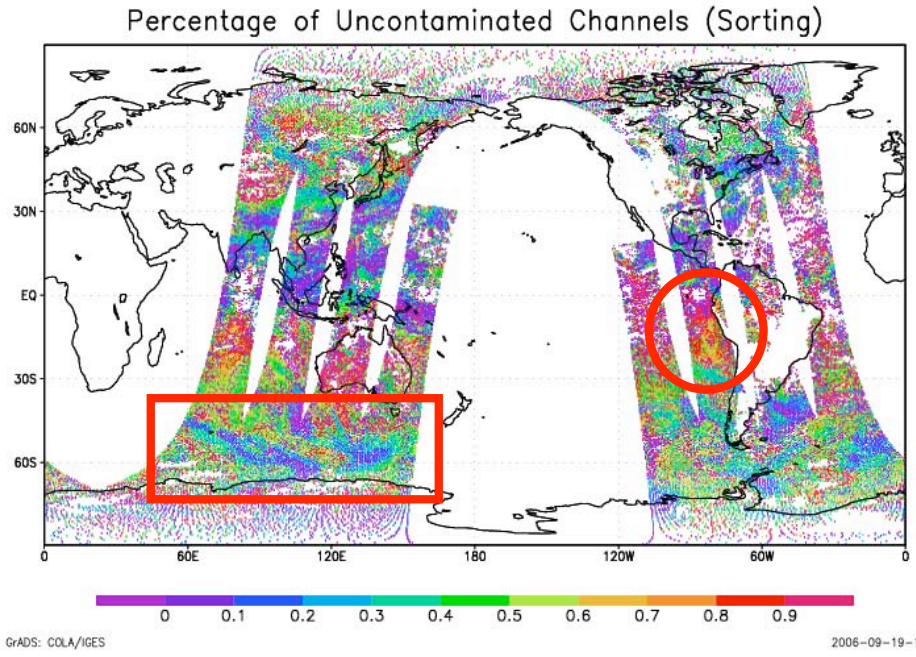
- Problem is more complicated than simple ΔBT
- Algorithm development is ongoing
- Preliminary tests
  - Determine if separation occurs
  - Determine if the scene is contaminated by high, dense clouds
- Separation tests
  - Three separate techniques determine the index location of the SP
- Plot shows optimal (black) and actual (red) cloud determination

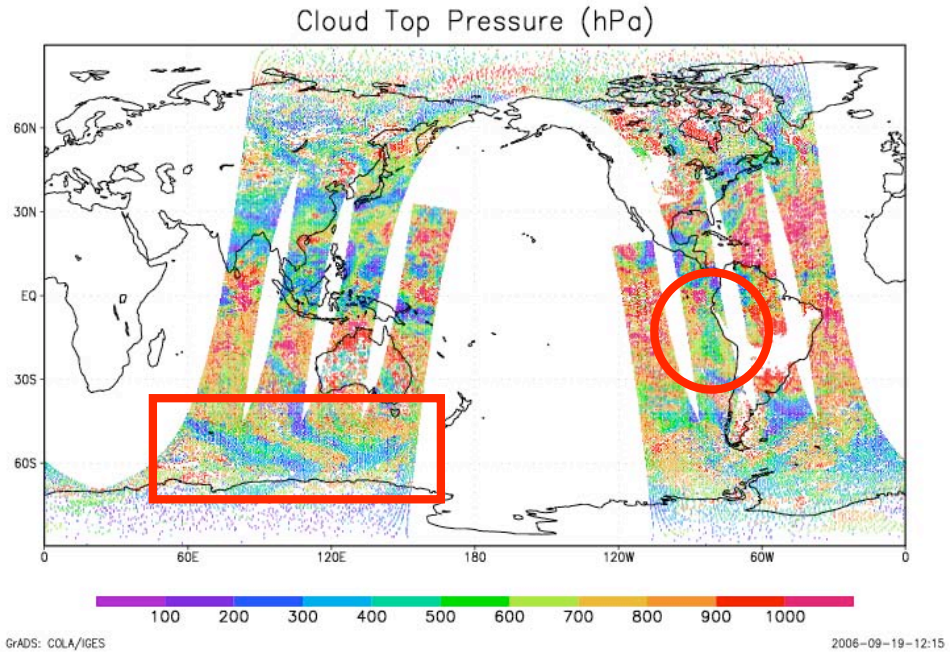
AIRS Cloud-free Channels



Preliminary assessment is that this method works well for clouds of all levels, though additional tuning is needed.

Initial Results from Sorting Technique



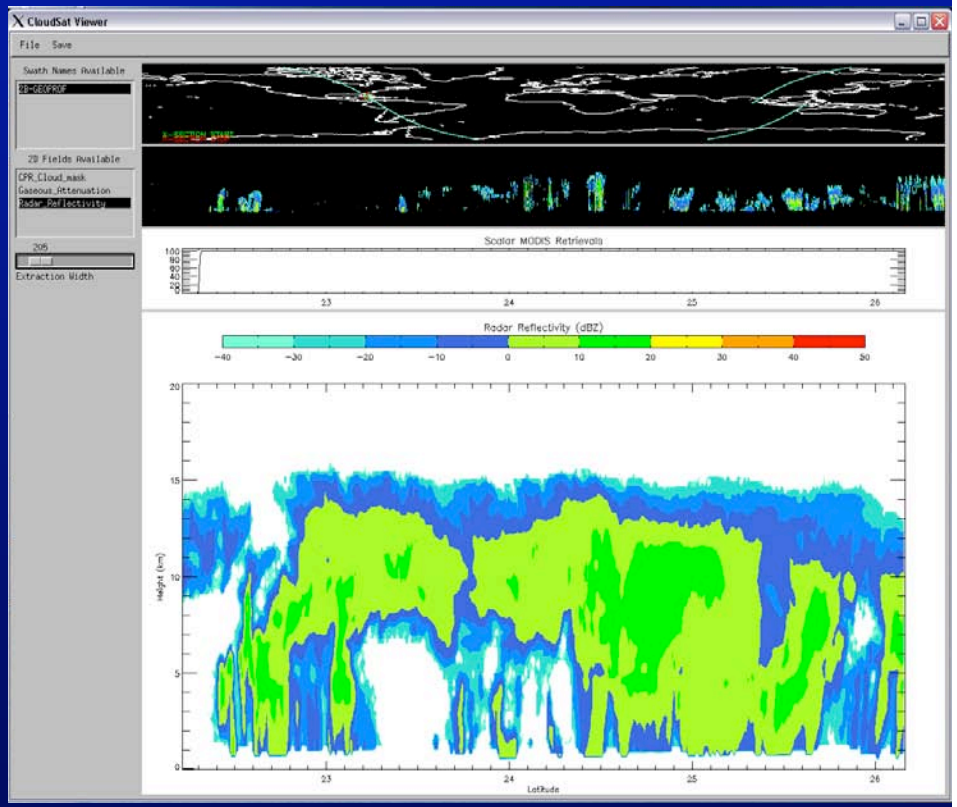


- Sorting technique compares well to the CO_2 Slicing CTP
- Cool colors - low percentage of usable channels (left) and high clouds (right)
- Warm Colors - High Percentage (left) and low clouds (right)

Validation of Slicing and Sorting Approach

Data Fusion on the A-Train Constellation

- Spaceborne Cloud Profiling Radar (CPR) on CloudSat - new level of validation
- CPR poorly handles thin cirrus
  - Will incorporate CALIOP data
- Developing local tools to incorporate measurements from various platforms for qualitative and quantitative analysis



Active measurements from CloudSat and CALIPSO compared to passive retrievals from AIRS to lead towards optimal assimilation of AIRS radiances

AIRS Radiance Assimilation in Regional Models

Moving Forward

- Continue sorting algorithm development and validation
  - Algorithm to be improved and accuracy to be assessed with CloudSat and CALIPSO data
  - Simultaneous validation of CO_2 slicing CTPs
  - Ability to assess accuracy of sorting algorithm within the GSI framework
- Move modeling activities forward
  - Some basic modeling has been done, but otherwise, the focus has been on the sorting algorithm and insertion into the analysis step
  - Assess Improvement of the addition of AIRS radiances to the analysis
  - Assess Improvement of sorting and slicing channel selection techniques to GSI-inherent technique